

REMARKS

Claims 1-5, 11-15 and 25-28 are pending in the application.

Drawing Objections

The Examiner objected to the drawings alleging the symbols “X” and “Y” and “ $\tan(1^\circ)$ ” recited in various claims (claims 25-28) must be shown or the feature(s) canceled from the claim(s).

In response, Applicants submit the present amendments to claims 25-28 obviate this objection. More particularly, the terms “X” and “Y” have been removed from the claims. Further, Applicants submit the symbols M and N, which relate to the number of pixel sections per inch. The concept of pixels per inch is well understood by those having ordinary skill in the art, and therefore, need not be explicitly illustrated. (*see* para. [0044]). However, Applicants note that pixel sections are adequately illustrated in FIGS. 5, 6, 9, 10 and 11 with respect to the recited distance “D.”

Thus, Applicants respectfully request that the Examiner withdrawn this objection.

Claim Objection

The Examiner objected to claims 1-5, 11-15 and 25-28 for various informalities.

In particular, the Examiner alleges the phrase “a definition of the three-dimensional image in the horizontal direction is less than the resolution by the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in the three-dimensional visible

range,” is confusing because it is not clear what is considered to be the definition of the “three-dimensional image.” Further, the Examiner contends:

The three-dimensional image is an optical illusion that happens in the brain of the observer. It is therefore not clear what is considered to be the “definition” of the three-dimensional image. Furthermore, the definition recited in the specification is referred to the definition of a pixel not the three-dimensional image.

(*Office Action*, p. 3).

In response, Applicants submit the present amendments to claims 1 and 14 obviate this objection.

Additionally, the Examiner objected to claims 25-28 as being indefinite since the claims fail to provide the physical meaning for “ $\tan(1^\circ)$ ”. The Examiner further contends that the meaning of this expression must be explicitly stated in the claims to make the scope of the claims clear. In response, Applicants submit the Examiner’s contention is erroneous and misplaced. Specifically, the term “ $\tan(1^\circ)$ ” does not have a physical meaning, but to the contrary, represents a numerical value. Additionally, because one of ordinary skill in the art would easily understand what this value represents, Applicants submit the claims objected to are sufficiently clear.

Thus, Applicants respectfully request that the Examiner withdraw this objection.

Further, the Examiner objected to claims 25-28 indicating the phrase “a definition X (dpi)” and the phrase “a definition Y(dpi)” is confusing and indefinite.

Applicants respectfully submit the present amendments to claims 25-28 obviate this objection.

Claim Rejections - 35 U.S.C. § 103

Claims 1, 3, 11-13, 14, 25 and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ichinose (US 4,987,447)

Failure To Establish Prima Facie Obviousness

The Examiner alleges that Ichinose discloses many of the features recited in claims 1 and 14, but further relies on: (1) unsupported “geometry” based on Applicants’ own disclosure; and (2) a further unsupported modification based on the contention that a minimum angular separation of eyesight of 1.0 or one minute is well known. Consequently, the Examiner has failed to articulate why one of ordinary skill in the art would modify the pixel pitch in view of the minimum angular separation of the eyesight of a human.

First, despite the unsupported features imported by the Examiner in making this rejection, Applicants submit that the Examiner has failed to establish *prima facie* obviousness. In particular, the Examiner has failed to articulate any logical reason that would have led the skilled artisan at the time of the invention to the claimed combination. In particular, the Examiner has failed to articulate any rationale for modifying the definition of a three-dimensional image based on the resolution of the eyesight of a viewer.

Furthermore, the Examiner has failed to provide objective evidence to support the rejection. Instead, the Examiner modifies a single reference until the resultant combination allegedly discloses all the features of Applicants’ claims. Moreover, the reason to combine proffered by the Examiner is found only in Applicants’ specification.

For example, in the rejection the Examiner allegedly derives the mathematical relationship $1/L > 25.4 / (DIS * \tan(a)) (dpi)$ based on the disclosure of Ichinose. However, the Examiner concedes that Ichinose fails to teach the recited equation $X (dpi) \geq 25.4 / (D * 0.000291)$. In fact, Ichinose fails to even mention a value which corresponds to X (dpi) dots per inch in relation to the distance D. More specifically, Ichinose fails to even establish any method for calculating how the pixel pitch is determined. Rather, Ichinose is directed to determining the pitch of each lenticular lens within a lenticular lens sheet based on a given pixel pitch array size.

In particular, to compensate for Ichinose's deficiencies, the Examiner alleges that it is well-known in the art that general eyesight is 1.0, which means a minimum angular separation, is 1/60 degree or one minute. The Examiner plugs this value into the equation $1/L > 25.4 / (DIS * \tan(a)) (dpi)$ to arrive at $X \geq 25.4 / (D * 0.000291)$. However, the resulting equation calculated by the Examiner is based on hindsight. There is simply no support within Ichinose or any other applied reference which supports the Examiners' combination of the minimum angle of separation to determine the recited equation $X (dpi) > 25.4 / (D * 0.000291)$. Nothing, other than hindsight, would lead one of ordinary skill in the art to so modify Ichinose.

For instance, the Examiner fails to articulate any rationale for using the minimum angle of separation, i.e. 1/60 degree, of human eyesight to determine the pixel pitch of a pixel array. Additionally, assuming for the sake of argument, that one of ordinary skill in the art would recognize the mathematical expressions derived by the Examiner and the "official notice" that eyesight is 1.0, which means a minimum angular separation, is 1/60 degree or one minute, Applicants submit that the Examiner has provided no reason to combine the minimum angle of separation with the derived mathematical expression as arranged in the claims. As a basic

requirement of obviousness, the Examiner must articulate some rational basis, found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the teachings as the Examiner attempts. MPEP §2143. Furthermore, the reason to combine cannot come only from Applicant's disclosure. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991).

However, the Examiner has failed to provide any such reason to combine. Furthermore, the only rational basis to make the combination attempted by the Examiner comes from the Applicants' own disclosure. Specifically, the present Application describes the study and discovery of the unrecognized problem related to the definition of a three-dimensional image and viewer fatigue. (specification, page 8, lines 15-20). As a result of this study, Applicants discovered that the visibility of the three-dimensional images had drastically reduced when the viewer significantly lacks perception of the corresponding feature points in the right and left images, which cause the fatigue. (specification, page 9, lines 2-7) Further, the Applicants discovered that to completely prevent the lack of feature points, the definition of the three-dimensional image need to be no less than the resolution by the eyesight of a viewer. (specification, pages 9 and 10).

Thus, Applicants recognized the problem of viewer fatigue and resolve this by combining the viewing geometries with the minimum viewing angle. While the Examiner appears to derive similar equations within the rejection, Applicants submit that this is a result of hindsight analysis as the Examiner has failed to provide any rational basis to support the derived combination.

More importantly, the Examiner misconstrues the applied references in this purported combination. Specifically, Applicants note the following errors with the Examiner's application of Ichinose:

(1) In the second paragraph of Page 5 of the Office Action, the description "As demonstrated by Figure 8, the smallest separation between the two adjacent image pixel sections that can be resolved by the eyes so that one image from the first pixel to be directed to the left eye and the other image from the adjacent second pixel section to the right eye is indicated in Figure 8 as L. And the definition of the pixel section is defined as $1/L$. From simple geometry one can calculate the definition of the pixel section as the following:"

However, this is incorrect. Referring to FIG. 8 of cited reference U.S. 4,987,487, "the smallest separation between two adjacent image pixel sections" is not L but 2L. Accordingly, the definition of the pixel sections is not $1/L$ but $1/2L$.

(2) In the last paragraph of Page 5 of the Office Action, there is a description " $L+e=(f*\tan(a))+(D*\tan(b))$, for paraxial light, $b=a$, and $\tan(a)$ approximately equals to a in radians and $\tan(b)$ approximately equals to b in radians. And if the optical unit is a parallax barrier with slits instead of the lenticular lens, the angle a will be equal to angle b."

However, why L and e are added is unclear. Notably, the Examiner has failed to provide any rational basis add L and e. Additionally, even when paraxial approximation exists, it can be said that $\tan(a)$ is approximately equal to a and $\tan(b)$ is approximately equal to b, but it cannot be said that $b=a$. Also, the angle of "b" is approximately 9 degrees when $a=65\text{mm}$ and

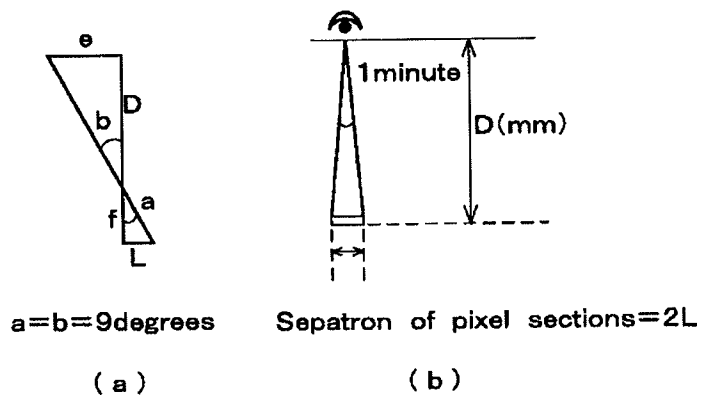
$D=400\text{mm}$ and not on the order of minutes (one minute= $1/60$ degrees). Consequently, the Examiner's result here is unsupportable.

(3) There is also a description "if the optical unit is a parallax barrier with slits," however, why the discussion that assumes a parallax barrier is included when calculation of a lens is being discussed is unclear.

(4) Furthermore, there is a description " $(f+D)*\tan(a)$ " in the 1st line of Page 6 of the Office Action, however, the reason why $\tan(a)$ remains despite the assumption that $\tan(a)=a$ is unclear. Therefore, the reason for transforming the expression as such is wholly unsupportable.

(5) Furthermore, there is a description "The definition of the pixel section ($1/L$)" in the 8th line of Page 6 of the Office Action, however, this is not ($1/L$) but, correctly, ($1/2L$) as described above.

(6) Furthermore, the Examiner provides, "This means the definition is $1/L > 25.4(D*\tan(1'))(\text{dpi})$." in the 12th and 13th lines of Page 6 of the Office Action, however, the left-hand side is not ($1/L$) but correctly, ($1/2L$) as described above. Therefore, the above



inequality is unlikely to hold true. Also, with regard to ($1'$) on the right-hand side of the above inequality, the reason why $1'$ (one minute) comes up here is unclear and unsupported. As described above, the Examiner argues that $a=b$. If so, " a " must be approximately 9 degrees as

described above, and it cannot be one minute (1/60 degrees). Consequently, the Examiner application of "a" and "b" and 1 minute, is illogical. In this way, the Examiner appears to be illogically manipulating Ichinose to arrive at the claimed invention.

(7) Finally, in the 17th to 20th lines of Page 9 of the Office Action, there is a description "The smallest separation ... is indicated in Figure 7 as Δ ." However, in FIG. 7 of cited reference U.S. 5,528,420, Δ indicates the pitch (separation) of one of the pixels of a pixel section, and the pixel section has a pitch of q , and thus, $q=3\Delta$.

Consequently, as set forth above, because the Examiner's reading of the applied references is erroneous, and the subsequent derivations in the Office Action are not supported by any logical rational, Applicants submit the Examiner has failed to provide the necessary objective evidence to establish a *prima facie* case of obviousness, and therefore, the rejection of claims 1, 3, 11-14, 25 and 27 is in error and should be withdrawn.

Even If Combined As Suggested Not All Claim Features Disclosed

Second, even if modified as suggested by the Examiner, Ichinose fails to teach or suggest, at least, "wherein the pixel sections are arrayed such that a number of pixel sections per inch in the horizontal direction is configured such that a resolution of the image in the horizontal direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in said three-dimensional visible range," as recited in claims 1 and 14.

Specifically, Ichinose does not mention or even contemplate the resolution of the eyesight of a viewer. Rather, Ichinose is directed to producing the three-dimensional image

properly to a viewer who moves left or right in a horizontal direction. In particular, Ichinose detects the binocular position of the viewer using a detection means so that the proper pixel for the left eye image is always incident on the left eye and the proper pixel for the right eye image is always incident on the right eye. (col. 1, lines 60-67; col. 4, lines 10-23). Specifically,

Ichinose discloses:

[T]he right and left image array control circuit 25 forms a signal for controlling an array of a combined image on the display device based on a binocular position signal as an output from the binocular or head position detecting circuit 24 which detects the binocular or head position of the viewer, and applies the signal to the multiplex circuit 23 to control a combination of the binocular signals. The resultant signal is applied to the stereoscopic display device 26 to control an array of R and L pixels on the combined image 1, as shown in FIGS. 3 or 4. Therefore, the viewer can experience stereoscopic viewing even if he or she moves to the right or to the left.

(col. 5, lines 45-58).

Accordingly, Ichinose is directed to changing which pixels display a particular portion of the image in response to the left and right movement of a viewer. To the contrary, claims 1 and 14 are directed to the number of pixel sections per inch in the horizontal direction beings configured such that a resolution of the image in the horizontal direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer in order to prevent a lack of feature points. Consequently, the resolution of the eyesight of a viewer is not contemplated or mentioned in Ichinose. Further, assuming, *arguendo*, one of ordinary skill in the art would recognize the that general eyesight is 1.0, which means the minimum angular separation is one minute, even if this is combined with Ichinose, the combination fails to disclose any relationship between the “definition of the three-dimensional image in the horizontal

direction” and “resolution by the eyesight of a viewer.” In other words, Ichinose and the Examiner alleged well-known eyesight of a viewer, at most, would disclose the following:

(1) the resolution of the eyesight of a viewer is one minute (Examiner’s contention); and

(2) changing which pixels display left and right images based on the movement of a viewer (Ichinose).

Accordingly, there is absolutely no disclosure related to the resolution of a viewer and the definition of a three-dimensional image.

Thus, because this feature is not disclosed or contemplated even if the references is modified in view of the resolution of viewer being one minute, Applicants submit claims 1 and 14 are allowable over the suggested modification of Ichinose. Additionally, Applicants submit claims 3, 11-13, 25 and 27 are allowable, at least because of their dependency.

Claim Rejections - 35 U.S.C. § 103(a) - Claims 2, 4, 15 and 17

The Examiner rejected claims 2, 4, 15, 26 and 28 as being unpatentable over Ichinose as applied above, in further view of Isono et al. (US 5,315,377). Applicants respectfully traverse this rejection.

Because Isono, either taken alone or in combination with Ichinose, fails to compensate for the above noted deficiencies of Ichinose as discussed above, Applicants submit that claims 2, 4, 15, 26 and 28 are allowable by virtue of their dependency.

Additionally, on page 7 of the Office Action, the Examiner contends “[i]t is implicitly true for square or rectangular type of pixel section, the same definition analysis disclosed above

also applied for the vertical direction of the matrix to allow the image being resolved by the eyes of the observer to achieve stereoscopic viewing.”

In response, Applicant submit herewith a reference (Reference 1), which provides objective evidence, that it had not always been considered that, when perceiving a three-dimensional image, an image having a higher resolution in the vertical and horizontal directions is preferable in perception.

In Reference 1 (Vision Vol. 17, No. 2, pp. 113-122, 2005), there is a description "As a feature different from that in a natural environment or of a two-dimensional image, a vergence or a retinal image difference occurs in a stereoscopic image due to provision of a binocular disparity and a visual object appears to protrude. However, the image exists on the screen surface, and misalignment with the screen surface in accommodation results in defocusing of the image. When this inconsistency in stimulation between the vergence and accommodation is considered to be the cause for fatigue, it goes well with the feature of the stereoscopic image. (Page 114 to Page 115)," there is a description "... a demand for accommodation due to defocusing was decreased. As a method for this, employed was a simple method for defocusing from a focusing mark ... the results indicate that the accommodative reaction approximates the position of protrusion in accordance with further defocusing from the mark. This can be understood that the demand for accommodation due to defocusing is weakened according to the defocusing. (Page 119), and there is a description "... if the results of the study introduced this time are correct, currently where image quality has been improved with the advances in image technology, images have been improved to appear more natural in many points, which is preferable, however, in so far as a stereoscopic image is concerned, it is doubtful whether an

improvement in image quality (opposite to defocusing) increases the inconsistency between the accommodation and vergence to easily cause fatigue. In at least an accommodative reaction, a more accurate alignment with the screen surface would have become necessary. However, whether this leads to fatigue is still unknown. It seems that some researchers have such a sense that supports the relationship, however, since we have not asked many researchers about this, its examination will become a challenge in the future (Page 120 to Page 121)."

As described in this Reference 1, it is not always a matter of course that a three-dimensional stereoscopic image preferably has a high definition. Furthermore, this Reference 1 was published in 2005, where it could not be positively stated that a three--dimensional image should preferably have a high definition even after the elapse of two years since the priority date of the present application. This is objective evidence of the prevailing sentiment at a period of time following this priority date.

Moreover, only as a result of repeated diligent experiments and study of the relationship between the definition of a stereoscopic image and viewer fatigue, as described in the specification of the present application, the inventors of the present invention obtained findings that it has been discovered that the visibility of the three-dimensional images had drastically reduced when the viewer significantly lacks perception of the corresponding feature points in the right and left images, which causes fatigue. Specifically, when the right and left eyes perceive images having a parallax from each other, the viewer searches for corresponding feature points. At this time, when the image significantly lacks feature points, the right and left images cannot correspond to each other, which causes viewer confusion. This confusion leads to binocular rivalry as to which of the images observed by the right and left eyes has priority. Since a

condition with binocular rivalry is an unstable condition where binocular fusion is impossible, the visibility of the three-dimensional images drastically reduces, and the viewer experiences fatigue. Therefore, for making stereoscopic viewing easy in order to reduce viewer fatigue, it is sufficient to prevent the lack of corresponding feature points in the right and left images. This allows the viewer to easily find the corresponding feature points in the right and left images, so that binocular rivalry can be prevented, and binocular fusion can consequently be easily attained.

Concretely, the constitution and effects have been reached as the inventors of the present invention have examined to what extent the lack of feature points can be permitted. In order to completely prevent the lack of feature points, it is necessary that the degree of definition of the three dimensional image be no less than the resolution of the eyesight of a viewer. This allows avoiding the phenomenon that the feature points that could have been perceived by the viewer cannot be perceived due to a low definition of the image so that the viewer lacks recognition of the feature points.

It has conventionally been a concern that the inconsistency between the vergence and accommodation may increase due to a high definition of the three-dimensional image and lead to fatigue. In order to cope therewith, the inventors of the present invention have discovered that fatigue can be reduced from a different viewpoint of a prevention of confusion in a feature point search and thus completed the present invention.

In Reference 1 described above, employed was a simple method for displaying a focusing mark in a defocused manner so as to decrease the demand for accommodation due to defocusing. In such a simplified case using a mark, since the number of feature points in an image is small in

the first place, even if the definition is lowered by defocusing, the right and left images can easily correspond to each other, so that the possibility of leading to binocular rivalry is considerably lowered.

On the other hand, in the present invention, a more realistic stereoscopic image is used as shown in, for example, FIG. 1. In such a display, since a large number of feature points exist, when the ratio of lacking increases due to a decline in definition, the right and left images can no longer correspond to each other to lead to binocular rivalry, so that the viewer experiences fatigue due to confusion. That is, in realistic three-dimensional images such as images that the viewer sees usually, it is important to prevent a lack of feature points.

Therefore, in such a stereoscopic image, the following three conditions exist. First, a condition where the definition is lowered such that most of the feature points are lacking, second, a condition where the definition is improved so that almost half of the feature points are not lacking, and third, a condition where the definition is improved no less than the resolution of the eyes so as to prevent a lack of feature points.

In the first condition, as described in Reference 1, the inconsistency between the vergence and accommodation is reduced, so that viewer fatigue may be reduced. In the second condition, since the inconsistency between the vergence and accommodation is further increased and confusion also occurs at the time of a feature point search, viewer fatigue increases. On the other hand, in the third condition, since a search for feature points becomes easier despite an increase in the inconsistency between the vergence and accommodation, fatigue is comprehensively reduced. As such, with regard to the relationship between the definition of a

three-dimensional image and an improvement in visibility, the visibility level relative to a change in definition has an inflection point, so that even though the definition is high, the visibility level is not improved, but is conversely lowered unless the definition is made equal to or higher than a predetermined definition. The present invention has presented a lower limit of the definition from such a viewpoint.

Moreover, in the present invention, the definition in the vertical and horizontal directions has been improved to the same extent, and as described in the specification of the present application, in the two directions orthogonal to each other of a display panel, the arrangement cycle of the respective pixels becomes not less than the viewer's minimum viewing angle, so that a lack of corresponding feature points in the right-eye and left-eye images can be more completely prevented, and as a result, the visibility of a three-dimensional image is further improved, and viewer fatigue can further be reduced.

Consequently, the above effects are enabled by the finding of the present invention that "preventing a lack of feature points can reduce viewer fatigue," and could not have been easily anticipated by those skilled in the art based on the conventional arts.

Thus, Applicants submit the Examiner's purported combination is unsupported for these additional reasons.

Claim Rejections - 35 U.S.C. § 103(a) - Claims 5 and 18

The Examiner rejected claims 5 as being unpatentable over Ichinose as applied above, in further view of Chikazawa (US 5,852,512). Applicants respectfully traverse this rejection.

Because Chikazawa, either taken alone or in combination with Ichinose, Applicants submit claim 5 is allowable, at least by virtue of its dependency.

Claim Rejections - 35 U.S.C. § 103(a) - Claims 1, 3, 11-14, 16, 25 and 27

The Examiner rejected claims 1, 3, 6, 8, 11-14, 16, 19, 21 and 24 as being unpatentable over Momochi (US 5,528,429) in view of Ichinose. Applicants respectfully traverse this rejection.

Because Momochi, either taken alone or in combination with Ichinose, fails to compensate for the above noted deficiencies of Ichinose as discussed above, Applicants submit claims 1 and 14 are allowable, at least for the same reasons set forth above. Additionally, Applicants submit claims 3, 6, 8, 11-13, 16, 19, 21 and 24 are allowable, at least by virtue of their dependency.

Claim Rejections - 35 U.S.C. § 103(a) - Claims 2, 4, 7, 9, 15, 17, 20 and 22

The Examiner rejected claims 2, 4, 7, 15, 26 and 28 as being unpatentable over Momochi (US 5,528,429) in view of Ichinose as applied to claims 1 and 14 above, and in further view of Isono. Applicants respectfully traverse this rejection.

Because Isono, either taken alone or in combination with Momochi and Ichinose, fails to compensate for the above noted deficiencies of Ichinose as discussed above with regard to claims 1 and 14, Applicants submit claims 2, 4, 7, 15, 26 and 28 are allowable, at least by virtue of their dependency.

Claim Rejections - 35 U.S.C. §103(a) - Claims 5, 10, 18 and 23

The Examiner rejected claim 5 as being unpatentable over Momochi and Ichinose as applied to claims 1, and in further view of Chikazawa. Applicants respectfully traverse this rejection.

Because Chikazawa fails to compensate for the above noted deficiency with regard to the Momochi/Ichinose combination, Applicants submit that claim 5 is allowable, at least because of its dependency.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

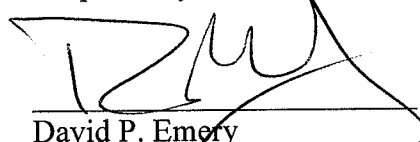
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